

CLAIMS

1. A GMPLS+IP/MPLS node which is used in a network in which a GMPLS
(Generalized Multi Protocol Label Switching) network and an IP (Internet Protocol)
5 network are mixed, the GMPLS network comprising a node having a GMPLS function,
the IP network comprising an IP/MPLS (Internet Protocol/Multi Protocol Label
Switching) node, and which constitutes the GMPLS network, and which processes a
GMPLS protocol and an IP/MPLS protocol, the GMPLS+IP/MPLS node comprising:
a device which establishes a GMPLS label path of a packet layer with another
10 GMPLS+IP/MPLS node in the GMPLS network; and
a device which tunnel transfers a packet transferred from the IP/MPLS node
with the other GMPLS+IP/MPLS node through the GMPLS label path.
2. A GMPLS+IP/MPLS node according to claim 1, further comprising a device
15 which advertises link state information of the GMPLS label path of the packet layer to
the IP/MPLS node by a router LSA (Label Switching Advertisement) as a normal link in
the IP/MPLS node.
3. A GMPLS+IP/MPLS node according to claim 2, further comprising:
20 a device which holds the link state information having the GMPLS label path of
the packet layer advertised as the link; and
a device which holds link state information inside of the GMPLS network.
4. A GMPLS+IP/MPLS node according to claim 2, further comprising a device

which converts a link of PSC-LSP (Packet Switch Capable-Label Switch Path) used for IP/MPLS from an unnumbered system into a numbered system to advertise as the link of the numbered system.

- 5 5. A GMPLS+IP/MPLS node according to claim 2, further comprising:
 a device which performs processing inside of the GMPLS network in
 accordance with an unnumbered system; and
 a device which converts a link of PSC-LSP used for IP/MPLS from the
 unnumbered system into a numbered system to advertise as the link of the numbered
10 system.
6. A GMPLS+IP/MPLS node according to claim 2, further comprising a device
 which advertises the GMPLS label switch path of the packet layer as a link of a
 numbered system.
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7. A GMPLS+IP/MPLS node according to claim 2, further comprising:
 a device which performs processing inside of the GMPLS network in
 accordance with an unnumbered system; and
 a device which converts the GMPLS label switch path of the packet layer from
20 the unnumbered system into a numbered system to advertise as the link of the numbered
 system.
8. A GMPLS+IP/MPLS node according to any one of claim 4 through claim 7,
 further comprising:
25 a device which previously stores an IP address; and

a device which uses the stored IP address as an IP address of the link of the numbered system.

9. A GMPLS+IP/MPLS node according to claim 2, further comprising an LSA
5 converting device which converts an Opaque LSA expressing a D-plane label path in the GMPLS network into a router LSA,

wherein when the label path is a point-to-point Link type of a numbered system, the LSA converting device changes a Link-State Advertisement Type to 1 corresponding to the router LSA, copies an Advertising Router value and an LS Sequence number
10 value, copies a Link ID field value in the Opaque LSA to a Link ID field of the router LSA, and copies a Local interface IP address field value in the Opaque LSA to a Link Data field of the router LSA expressing a router interface's IP address.

10. A GMPLS+IP/MPLS node according to claim 2, further comprising an LSA
15 converting device which converts an Opaque LSA expressing a D-plane label path in the GMPLS network into a router LSA,

wherein when the label path is a point-to-point Link type of an unnumbered system, the LSA converting device changes a Link-State Advertisement Type to 1 corresponding to the router LSA, copies an Advertising Router value and an LS
20 Sequence number value, copies a Link ID field value in the Opaque LSA to a Link ID field of the router LSA, and copies a Link Local Identifiers field value in the Opaque LSA to a Link Data field of the router LSA expressing an ifIndex value.

11. A GMPLS+IP/MPLS node according to claim 2, further comprising an LSA
25 converting device which converts an Opaque LSA expressing a D-plane label path in the

GMPLS network into a router LSA,

wherein when the label path is a multi-access Link type, the LSA converting device changes a Link-State Advertisement Type to 1 corresponding to the router LSA, copies an Advertising Router value and an LS Sequence number value, copies a Link ID field value in the Opaque LSA to a Link ID field of the router LSA, and copies a Local interface IP address field value in the Opaque LSA to a Link Data field of the router LSA expressing a router interface's IP address.

12. A GMPLS+IP/MPLS node according to any one of claim 9 through claim 11, further comprising:

an LSA identifying device which receives a router LSA generated by another GMPLS+IP/MPLS node and identifies whether the router LSA advertises a C-plane of the GMPLS network, or whether the router LSA is obtained by converting an Opaque LSA expressing the GMPLS label path; and

a link state holding device which holds link state information of the GMPLS network,

wherein the LSA identifying device searches the link state holding device of the GMPLS+IP/MPLS node itself using an Advertising Router value and an LS Sequence number value included in the received router LSA as a key, and when link state information having the same Advertising Router and LS Sequence number as the received router LSA is held in the link state holding device, the LSA identifying device judges that the received router LSA is obtained by converting the Opaque LSA expressing the GMPLS label path.

13. A GMPLS+IP/MPLS node according to claim 2, further comprising an LSA

converting device which converts an Opaque LSA expressing a D-plane label path in the GMPLS network into a router LSA,

wherein when the label path is a point-to-point Link type of a numbered system, the LSA converting device changes a Link-State Advertisement Type to 1 corresponding to the router LSA, copies an Advertising Router value, turns on a label path conversion flag which shows that the Opaque LSA expressing the D-plane label path in the GMPLS network is converted into the router LSA, copies a Link ID field value in the Opaque LSA to a Link ID field of the router LSA, and copies a Local interface IP address field value in the Opaque LSA to a Link Data field of the router LSA expressing a router interface's IP address.

14. A GMPLS+IP/MPLS node according to claim 2, further comprising an LSA converting device which converts an Opaque LSA expressing a D-plane label path in the GMPLS network into a router LSA,

wherein when the label path is a point-to-point Link type of an unnumbered system, the LSA converting device changes a Link-State Advertisement Type to 1 corresponding to the router LSA, copies an Advertising Router value, turns on a label path conversion flag which shows that the Opaque LSA expressing the D-plane label path in the GMPLS network is converted into the router LSA, copies a Link ID field value in the Opaque LSA to a Link ID field of the router LSA, and copies a Link Local Identifiers field value in the Opaque LSA to a Link Data field of the router LSA expressing an ifIndex value.

15. A GMPLS+IP/MPLS node according to claim 2, further comprising an LSA converting device which converts an Opaque LSA expressing a D-plane label path in the

GMPLS network into a router LSA,

wherein when the label path is a multi-access Link type, the LSA converting device changes a Link-State Advertisement Type to 1 corresponding to the router LSA, copies an Advertising Router value, turns on a label path conversion flag which shows
 5 that the Opaque LSA expressing the D-plane label path in the GMPLS network is converted into the router LSA, copies a Link ID field value in the Opaque LSA to a Link ID field of the router LSA, and copies a Local interface IP address field value in the Opaque LSA to a Link Data field of the router LSA expressing a router interface's IP address.

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16. A GMPLS+IP/MPLS node according to any one of claim 13 through claim 15, further comprising:

an LSA identifying device which receives a router LSA generated by another GMPLS+IP/MPLS node and identifies whether the router LSA advertises a C-plane of
 15 the GMPLS network, or whether the router LSA is obtained by converting an Opaque LSA expressing the GMPLS label path; and

a link state holding device which holds link state information of the GMPLS network,

wherein the LSA identifying device searches the link state holding device of the
 20 GMPLS+IP/MPLS node itself using an Advertising Router value and a label path conversion flag included in the received router LSA as a key, and when link state information having the same Advertising Router value as the received router LSA and having the label path conversion flag turned on is held in the link state holding device, the LSA identifying device judges that the received router LSA is obtained by converting
 25 the Opaque LSA expressing the GMPLS label path.

17. A GMPLS+IP/MPLS node according to claim 2, further comprising a device which, when a C-plane topology of the GMPLS network is advertised by the router LSA, an IP/MPLS node receiving the router LSA recognizes the C-plane topology of the GMPLS network, and an IP/MPLS node having information regarding the topology outputs a request to specify the C-plane of the GMPLS network and to establish an MPLS label path, and if there is a GMPLS label path having the corresponding nodes on opposite ends of a C-plane link on a route specified by the request, allocates the specified route to the GMPLS label path.
18. A GMPLS+IP/MPLS node according to claim 2, further comprising a device which, when a C-plane topology of the GMPLS network is advertised by the router LSA, an IP/MPLS node receiving the router LSA recognizes the C-plane topology of the GMPLS network, and an IP/MPLS node having information regarding the topology outputs a request to specify the C-plane of the GMPLS network and to establish an MPLS label path, and if there is no GMPLS label path having the corresponding nodes on opposite ends of a C-plane link on a route specified by the request, in response to an MPLS label path establishment request output from the IP/MPLS node, newly establishes a label path on a D-plane corresponding to opposite nodes of the C-plane link, and allocates the specified route to the newly established label path.
19. A GMPLS+IP/MPLS node according to claim 17 or claim 18, further comprising a device which, when the GMPLS label path having the corresponding nodes on opposite ends of the C-plane link of the GMPLS network specified by the IP/MPLS node is allocated, and if the GMPLS+IP/MPLS node itself directly receives the request

from the IP/MPLS node, transfers data which is transferred from the IP/MPLS node, not to the route specified by the IP/MPLS node, but to the allocated GMPLS label path.

20. An IP/MPLS node which is used in a network in which a GMPLS network and
5 an IP network are mixed, the GMPLS network comprising a node having a GMPLS
function, the IP network comprising an IP/MPLS node, and which is connected to the
GMPLS network, and a GMPLS+IP/MPLS node which constitutes the GMPLS network
and which is capable of processing a GMPLS protocol and an IP/MPLS protocol
establishes a GMPLS label path of a packet layer with another GMPLS+IP/MPLS nodes
10 in the GMPLS network,

the IP/MPLS node comprising a device which holds link state information
having a GMPLS label path of the packet layer advertised as a link.

21. A network in which GMPLS and IP/MPLS are mixed, comprising:
15 a GMPLS+IP/MPLS node according to any one of claim 1 through claim 19;
and

an IP/MPLS node which is connected to the GMPLS network, and which is
provided with a device which holds link state information having a GMPLS label path of
the packet layer advertised as a link.

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22. A packet communication method in a network in which a GMPLS network and
an IP network are mixed, the GMPLS network comprising a node having a GMPLS
function, the IP network comprising an IP/MPLS node, and the IP/MPLS node transfers
a packet with the node having the GMPLS function, the packet communication method
25 comprising:

a step of providing a GMPLS+IP/MPLS node which is capable of processing a GMPLS protocol and an IP/MPLS protocol and which is directly connected to the IP network among nodes having the GMPLS function constituting the GMPLS network;

a step of establishing a GMPLS label path of a packet layer with another
5 GMPLS+IP/MPLS node in the GMPLS network by the GMPLS+IP/MPLS node; and

a step of tunnel transferring a packet transferred from the IP/MPLS node with the other GMPLS+IP/MPLS node through the GMPLS label path.

23. A packet communication method according to claim 22, wherein link state
10 information of the GMPLS label path of the packet layer is advertised to the IP/MPLS node by a router LSA as a normal link in the IP/MPLS node.

24. A packet communication method according to claim 22, wherein link state
information of the GMPLS label path of the packet layer is advertised to the IP/MPLS
15 node by an Opaque LSA which can be processed by an MPLS router as a normal link in the IP/MPLS node.

25. A packet communication method according to claim 23, wherein link state
information having the GMPLS label path of the packet layer advertised as the link is
20 held, and link state information inside of the GMPLS network is held.

26. A packet communication method according to claim 23, wherein a link of PSC-
LSP used for IP/MPLS is converted from an unnumbered system into a numbered system
and is advertised as the link of the numbered system.

27. A packet communication method according to claim 23, wherein the GMPLS network performs processing in accordance with an unnumbered system, and a link of PSC-LSP used for IP/MPLS is converted from the unnumbered system into a numbered system and is advertised as the link of the numbered system.

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28. A packet communication method according to claim 23, wherein the GMPLS label switch path of the packet layer is advertised as the link of a numbered system.

29. A packet communication method according to claim 23, wherein the GMPLS network performs processing in accordance with an unnumbered system, and the GMPLS label switch path of the packet layer is converted from the unnumbered system into a numbered system, and is advertised as the link of the numbered system.

30. A packet communication method according to any one of claim 26 through claim 29, wherein an IP address is previously stored, and the stored IP address is used as an IP address of the link of the numbered system.

31. A packet communication method according to claim 23, wherein in order to convert an Opaque LSA expressing a D-plane label path in the GMPLS network into a router LSA, when the label path is a point-to-point Link type of a numbered system, a Link-State Advertisement Type is changed to 1 corresponding to the router LSA, an Advertising Router value and an LS Sequence number value are copied, a Link ID field value in the Opaque LSA is copied to a Link ID field of the router LSA, and a Local interface IP address field value in the Opaque LSA is copied to a Link Data field of the router LSA expressing a router interface's IP address.

32. A packet communication method according to claim 23, wherein in order to convert an Opaque LSA expressing a D-plane label path in the GMPLS network into a router LSA, when the label path is a point-to-point Link type of an unnumbered system, a Link-State Advertisement Type is changed to 1 corresponding to the router LSA, an Advertising Router value and an LS Sequence number value are copied, a Link ID field value in the Opaque LSA is copied to a Link ID field of the router LSA, and a Link Local Identifiers field value in the Opaque LSA is copied to a Link Data field of the router LSA expressing an ifIndex value.
33. A packet communication method according to claim 23, wherein in order to convert an Opaque LSA expressing a D-plane label path in the GMPLS network into a router LSA, when the label path is a multi-access Link type, a Link-State Advertisement Type is changed to 1 corresponding to the router LSA, an Advertising Router value and an LS Sequence number value are copied, a Link ID field value in the Opaque LSA is copied to a Link ID field of the router LSA, and a Local interface IP address field value in the Opaque LSA is copied to a Link Data field of the router LSA expressing a router interface's IP address.
34. A packet communication method according to any one of claim 31 through claim 33, wherein a router LSA generated by another GMPLS+IP/MPLS node is received, and
- in order to identify whether the router LSA advertises a C-plane of the GMPLS network or whether the router LSA is obtained by converting an Opaque LSA expressing the GMPLS label path, a link state holding device of its own GMPLS+IP/MPLS node

which holds link state information of the GMPLS network is searched, using an Advertising Router value and an LS Sequence number value included in the received router LSA as a key, and

- when link state information having the same Advertising Router and LS Sequence number as the received router LSA is held in the link state holding device, it is judged that the received router LSA is obtained by converting the Opaque LSA expressing the GMPLS label path.

35. A packet communication method according to claim 23, wherein in order to convert an Opaque LSA expressing a D-plane label path in the GMPLS network into a router LSA, when the label path is a point-to-point Link type of a numbered system, a Link-State Advertisement Type is changed to 1 corresponding to the router LSA, an Advertising Router value is copied, a label path conversion flag which shows that the Opaque LSA expressing the D-plane label path in the GMPLS network is converted into the router LSA is turned on, a Link ID field value in the Opaque LSA is copied to a Link ID field of the router LSA, and a Local interface IP address field value in the Opaque LSA is copied to a Link Data field of the router LSA expressing a router interface's IP address.

36. A packet communication method according to claim 23, wherein in order to convert an Opaque LSA expressing a D-plane label path in the GMPLS network into a router LSA, when the label path is a point-to-point Link type of an unnumbered system, a Link-State Advertisement Type is changed to 1 corresponding to the router LSA, an Advertising Router value is copied, a label path conversion flag which shows that the Opaque LSA expressing the D-plane label path in the GMPLS network is converted into

the router LSA is turned on, a Link ID field value in the Opaque LSA is copied to a Link ID field of the router LSA, and a Link Local Identifiers field value in the Opaque LSA is copied to a Link Data field of the router LSA expressing an ifIndex value.

5 37. A packet communication method according to claim 23, wherein in order to convert an Opaque LSA expressing a D-plane label path in the GMPLS network into a router LSA, when the label path is a multi-access Link type, a Link-State Advertisement Type is changed to 1 corresponding to the router LSA, an Advertising Router value is copied, a label path conversion flag which shows that the Opaque LSA expressing the D-
10 plane label path in the GMPLS network is converted into the router LSA is turned on, a Link ID field value in the Opaque LSA is copied to a Link ID field of the router LSA, and a Local interface IP address field value in the Opaque LSA is copied to a Link Data field of the router LSA expressing a router interface's IP address.

15 38. A packet communication method according to any one of claim 35 through claim 37, wherein a router LSA generated by another GMPLS+IP/MPLS node is received, and

in order to identify whether the router LSA advertises a C-plane of the GMPLS network or whether the router is obtained by converting an Opaque LSA expressing the
20 GMPLS label path, a link state holding device of its own GMPLS+IP/MPLS node which holds link state information of the GMPLS network is searched using an Advertising Router value and a label path conversion flag included in the received router LSA as a key, and

when link state information having the same Advertising Router value as the
25 received router LSA and having the label path conversion flag turned on is held in the

link state holding device, it is judged that the received router LSA is obtained by converting the Opaque LSA expressing the GMPLS label path.

39. A packet communication method according to claim 23, wherein

5 the GMPLS+IP/MPLS node advertises a C-plane topology of the GMPLS network by the router LSA,

an IP/MPLS node receiving the router LSA recognizes the C-plane topology of the GMPLS network,

an IP/MPLS node having information regarding the topology outputs a request
10 to specify the C-plane of the GMPLS network and to establish an MPLS label path, and

if there is a GMPLS label path having the corresponding nodes on opposite ends of a C-plane link on a route specified by the request, the GMPLS+IP/MPLS node allocates the specified route to the GMPLS label path.

15 40. A packet communication method according to claim 23, wherein

the GMPLS+IP/MPLS node advertises a C-plane topology of the GMPLS network by the router LSA,

an IP/MPLS node receiving the router LSA recognizes the C-plane topology of the GMPLS network,

20 an IP/MPLS node having information regarding the topology outputs a request to specify the C-plane of the GMPLS network and to establish an MPLS label path, and

if there is no GMPLS label path having the corresponding nodes on opposite ends of a C-plane link on a route specified by the request, in response to an MPLS label path establishment request output from the IP/MPLS node as a trigger, the

25 GMPLS+IP/MPLS node newly establishes a label path on a D-plane corresponding to

opposed nodes of the C-plane link, and allocates the specified route to the newly established label path.

41. A packet communication method according to claim 39 or claim 40, wherein
5 when the GMPLS label path having the corresponding nodes on opposite ends of the C-plane link of the GMPLS network specified by the IP/MPLS node is allocated, a GMPLS+IP/MPLS node which directly receives the request from the IP/MPLS node transfers data which is transferred from the IP/MPLS node, not to the route specified by the IP/MPLS node, but to the allocated GMPLS label path.
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42. A packet communication method according to claim 23, wherein the IP/MPLS node holds link state information having the GMPLS label path of the packet layer advertised as a link.
- 15 43. A method for configuring a network in which GMPLS and IP/MPLS are mixed, comprising:
- providing a GMPLS+IP/MPLS node which transfers a packet using a packet communication method according to any one of claim 22 through claim 42; and
- providing an IP/MPLS node which transfers a packet, and which advertises link
20 state information of the GMPLS label path of the packet layer to the IP/MPLS node by a router LSA as a normal link in the IP/MPLS node, and which holds link state information having the GMPLS label path of the packet layer advertised as the link.